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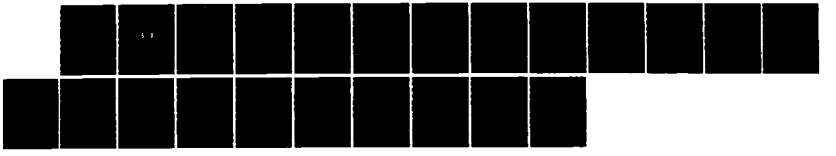

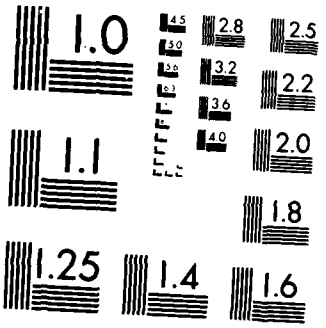

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REPORT ON THE ARCHAEOLOGICAL AERIAL SURVEY OF LAKE ASHTABULA, NORTH DAKOTA

Date: Oct 1976

Submitted to
the Army Corps of Engineers
Saint Paul District
DACW37-77-M-0206

Submitted by
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The purpose of this report is to present the results of an archaeological aerial survey conducted at Lake Ashtabula, North Dakota. One goal of this project is to provide the Army Corps of Engineers with data on the location of archaeological information which may be effected by on-going erosion. A second goal is to test and present the results of specific remote-sensing techniques as applied to site location and cultural resource management in the north central area of the United States.

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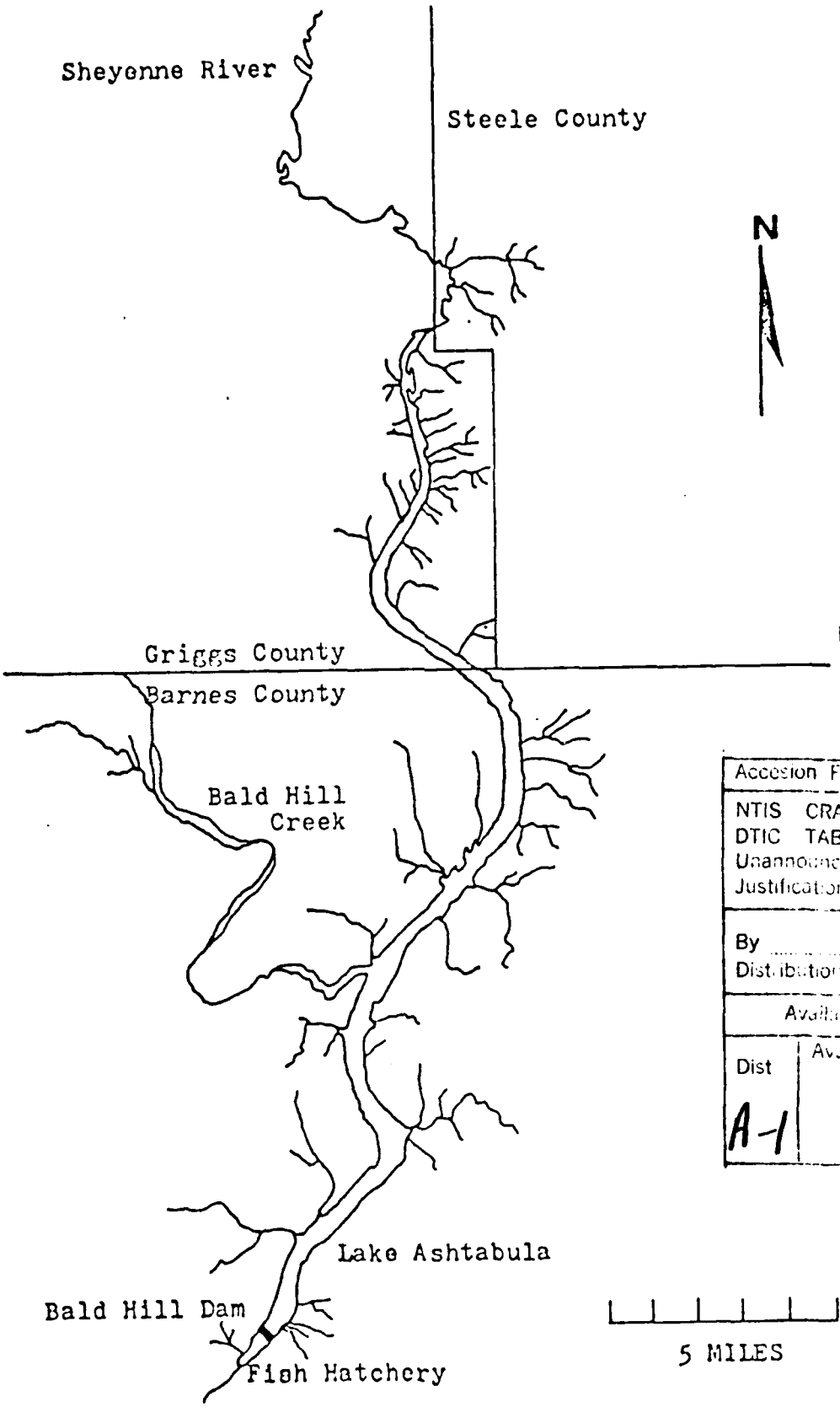
Archaeological surface reconnaissance in certain cultural/ecological situations can be an insufficient technique for documenting areas of past cultural behavior. Often buried prehistoric and historic sites have no surface manifestations. In addition, the process of evaluation of a site, though normally not an important part of preliminary survey, is extremely limited in archaeological surface reconnaissance.

The purpose of the following report is to present the results of an archaeological aerial survey conducted at Lake Ashtabula, North Dakota (See Figure 1). Presently, the lake and its cultural resources are under the jurisdiction of the Army Corps of Engineers. One goal of this project is to provide the Army Corps of Engineers with data on the location of archaeological information which may be effected by the on-going erosion which occurs at any lake of this sort. A second goal of this project is to test and present the results of specific remote-sensing techniques as applied to site location and cultural resource management in the north central area of the United States.

As Gumerman and Lyons clearly state, "there is no one all-purpose remote-sensing device on which the archaeologist can rely that will reveal all evidence of human occupations. Remote-sensing data will not replace the traditional ground-based survey, but, used judiciously, data gathered from aerial reconnaissance can reveal many cultural features unsuspected from the ground (1971: 131). It is our intention, then, to present evidence of probable site locations at Lake Ashtabula which were neither noted or

Figure 1 General Map of the Lake Ashtabula Area



recorded previously; to demonstrate the extent and nature of these sites, as well as others previously noted but not thoroughly evaluated; and to suggest within a probabilistic framework the potential, in terms of cultural resources, of various locations along the lake shore.

It will be necessary to consider this report preliminary. It is so because we do not intend, nor is a goal of this project, to do the field checking which would allow for adequate evaluation of the strength of our predictive probabilities. We believe, however, that this must be done at some future date. The combination of the results of our report and field evaluation hopefully will serve as a model which might allow later archaeologists to complete their projects more efficiently and at a higher reliability level.

After a review of the archaeological literature on these projects, as well as previous experiments conducted by the authors, infrared color film was chosen as the medium for our basic analysis. Infrared color film is sensitized to green, red, and infrared light instead of blue, green, and red as with normal color film. As with all color films, the sensitivity is based on layers of emulsion. Each layer is sensitive to a specific band of light. In infrared film, all the layers are sensitive to blue light. Thus, a yellow filter was used during the exposure which prevented the blue light from exposing the emulsion. After processing, a yellow positive image was recorded in the green-sensitive layer; magenta appeared in the red-sensitive layer and cyan in the infrared layer. It should be noted that blue will show up in the transperancy as a result of the combination of yellow and cyan. All colors are

possible in the final image as a result of the combination of the three basic colors at their various strengths. Leaves, for example, show up in various shades of red because they are "bright" in the infrared layer leaving a light cyan image allowing red from the other layers of emulsion to dominate (Eastman Kodak, 1974:4).

Infrared film yields a false image of nature, an image which reflects variances in plant growth, soil temperatures, and tree color. It is this falsity, based upon the combination of these factors, which allowed us to see otherwise "invisible" things.

In some instances, human habitation and activity are visible to the unaided eye. In many instances they are not. Nevertheless, human habitation and activity modifies soil porosity, mineral and organic content which in turn modifies the nature of and/or growth of the plants present as well as the heat retention.

Based upon our research during an aerial infrared reconnaissance of a number of archaeological sites on and around Swan Lake, Nicollet County, Minnesota, we noted that it was possible to differentiate various kinds of cultural activity. A number of habitation sites were characterized by dark red, clustered, circular and ovate forms. We postulated that these were prehistoric houses and the dark red color a result of deposition of humus material from occupation and subsequent decay of the structures. Excavation of one of these sites (21NI30) verified this hypothesis. Another site recorded during this aerial survey was a ridge containing a number of burial mounds. Though recorded at the turn of the century, years of plowing obliterated any physiographic indications of their pattern. Infrared transperancies showed a number of light

colored, circular shaped forms on a moderate background. We postulated that the light color was a result of lack of humus in the soil brought in to cover the dead. The transperancy, when projected upon the original group drawn from data no longer visible on the surface, matched that map on an almost perfect one-to-one basis.

Remote-sensing in archaeology, however, is neither new nor unique to this project. Nor is the use of infrared in this process. Avery (In Press:471-472) presents an excellent short summary of its use in archaeology since 1932. European archaeologists have been using it routinely on very large scale sites. Debate, however, continues to exist as to which film is the most successful (Ebert and Hitchcock, In Press:22). "There does seem to be general agreement that color exposures are superior to black and white even when that superiority is limited to a saving of interpretation time (Avery, In Press:353). In addition, there is agreement that dry conditions are better for most aerial reconnaissance, though some sites will only be visible after rainstorms (Martin, 1971:353). Additionally, a true verticle angle minimizes distortion and aids in the interpretation process (Eastman Kodak, 1971:21).

Lastly, it should be noted that aerial reconnaissance has been utilized in South Dakota in 1965 and of its potential Lehmer comments that "if the techniques had been developed during the early years of salvage work in the Middle Missouri, and if funds had been available to use them, this approach could have been useful to the operation" (1971:21).

The area of the survey was the eastern side of Lake Ashtabula

which is located in the northwestern part of North Dakota. Only the east side of the lake was chosen to minimize the detail of the project. In addition, a control area was left for later confirmation of hypothesis. Lake Ashtabula is the reservois created by the construction of the Bald Hill Dam on the Sheyenne River. It is approximately 25 miles long running generally north to south. The revine area itself contains three basic econiches: prairie grasslands which surround it; the bluffs which overlook the Sheyenne River and its tributaries; and the riverbottom/floodplain. The latter is currently underwater. Three kinds of historic activity take place on the bluffs and prairie grassland areas-building construction, cropping, and grazing with the latter being the most predominant.

Wedel's (1961) analysis of Plains archaeology classifies the Lake Ashtabula area as the north central sub-area of the Plains Tradition. He identifies four chronologically sequenced cultural traditions-Big Game Hunting, Plains Archaic, Woodland, and Plains Village. These obviously will evidence different kinds of occupations which should be reflected in the infrared transperancies. Village patterns of some of the later sites (for example, see the Red Horse Hawk Site, Lehmer, 1971:34) closely approximate some of the evidence we will present below. Sites from the earlier periods will be put in more probabilistic terms.

The research began with a check of the existing literature and general study of the ecological zones at Lake Ashtabula. Helicopter support was arranged by the Army Corps of Engineers and a flight path established from the northern end of the lake to

Bald Hill Dam along the east perimeter. A one thousand foot elevation was maintained throughout the photographing process at a land speed of approximately 30 knots. In all, three cameras were employed. Each was a 35 mm, single lens reflex with through-the-lens metering and 55 mm focal length on the lens. This meant that the standard 35 mm transperancy would cover a ground area of approximately 600' by 400' and with the rewind efficiency and ground speed, we had ample time for a 10 percent overlap. The film utilized was Kodak Ektachrome Infrared. Two cameras were loaded with infrared, one being in use while the other was reloaded. The filter used was the Tiffen equivalent of the Kodak Wratten-12. The third camera was loaded with High Speed Ektachrome and was utilized intermittently go give true color comparison to the false color infrared.

The infrared transperancies were shot close to a verticle angle while the true color transperancies were shot at a high oblique. All films were sent to the Kodak laboratories for processing.

The first step in the analysis was to locate on the aerial infrared transperancies the already recorded sites from the Lake Ashtabula area (see Figure 2). The second step in the analysis was to then identify areas which appeared on the infrared transperancies to have high similarity to the known cultural resources identified above. Then, additional anomalities which could not be explained by known natural or recent cultural activity were also identified.

In addition to these steps, all suggested areas of possible cultural significance were submitted to external comparison. By

Figure #2 Location of Documented Sites on Lake Ashtabula

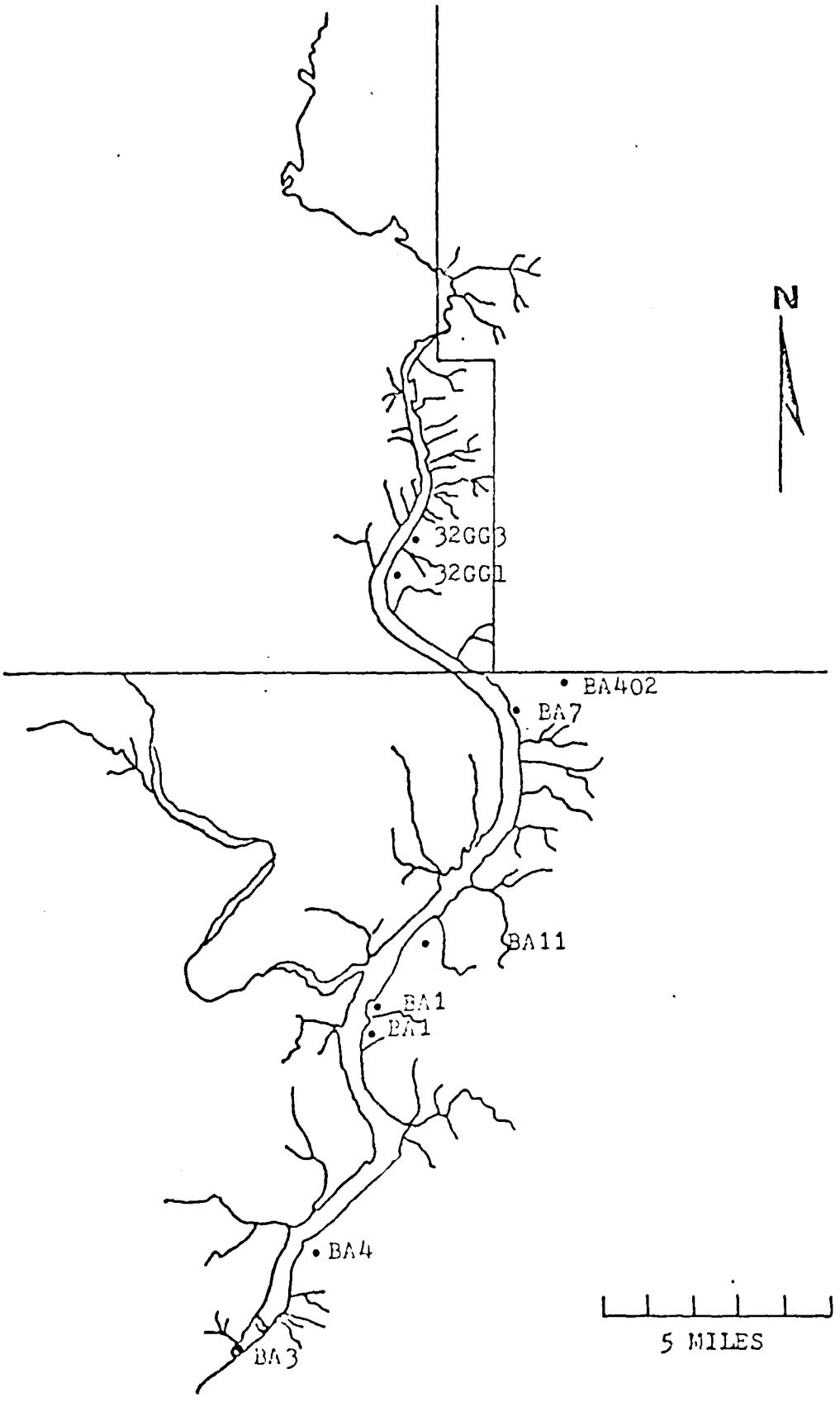


Figure 2a Archaeological Sites of the Lake Ashtabula Area

SITE	DESCRIPTION
Barnes County	
32BA1	Mound Site
32BA2	Inundated
32BA3	Occupation Site
32BA4	Mound Site
32BA5	Inundated
32BA6	Inundated
32BA7	Undetermined
Griggs County	
32GG1	Mound Site
32GG2	Occupation Site
32GG3	Occupation Site

this we mean that they were compared to other aerial reconnaissance projects particularly the Swan Lake project described above.

The data was then organized in the following manner 1) All known sites identified on the infrared transperancies, all areas with infrared configurations similar to these known sites, and all infrared configurations similar to those identified in other projects were labelled as areas of highly probable prehistoric activity; 2) these infrared configurations which do not appear to be explicable in terms of natural phenomenon or recent cultural activity are classified as areas of moderately probable prehistoric activity; and the remaining areas are considered to be of low probability in terms of prehistoric cultural activity.

The transperancies presented as Appendix I to this report are numbered sequentially beginning at the northern-most point of the survey. Specific slides in this analysis can be referred to by their sequence number. In addition, Figure 3 is provided to show the location of some of the transperancies in relation to the lake. Appendix II contains the true color transperancies numbered in the same fashion.

In Figure 4 we can see the results, as well as the associated sequence of numbers, of the Lake Ashtabula survey.

As we pointed out in the beginning of the report, field verification is necessary for the ultimate evaluation and utilization of the method presented here. As an initial step, we suggest that a significant, randomly selected number of locations of both the high and moderate probability areas be intensively investigated. Also, we suggest that a significant area from various locations

Figure #3 Location of Infrared and Color Slides in Relation to the Lake

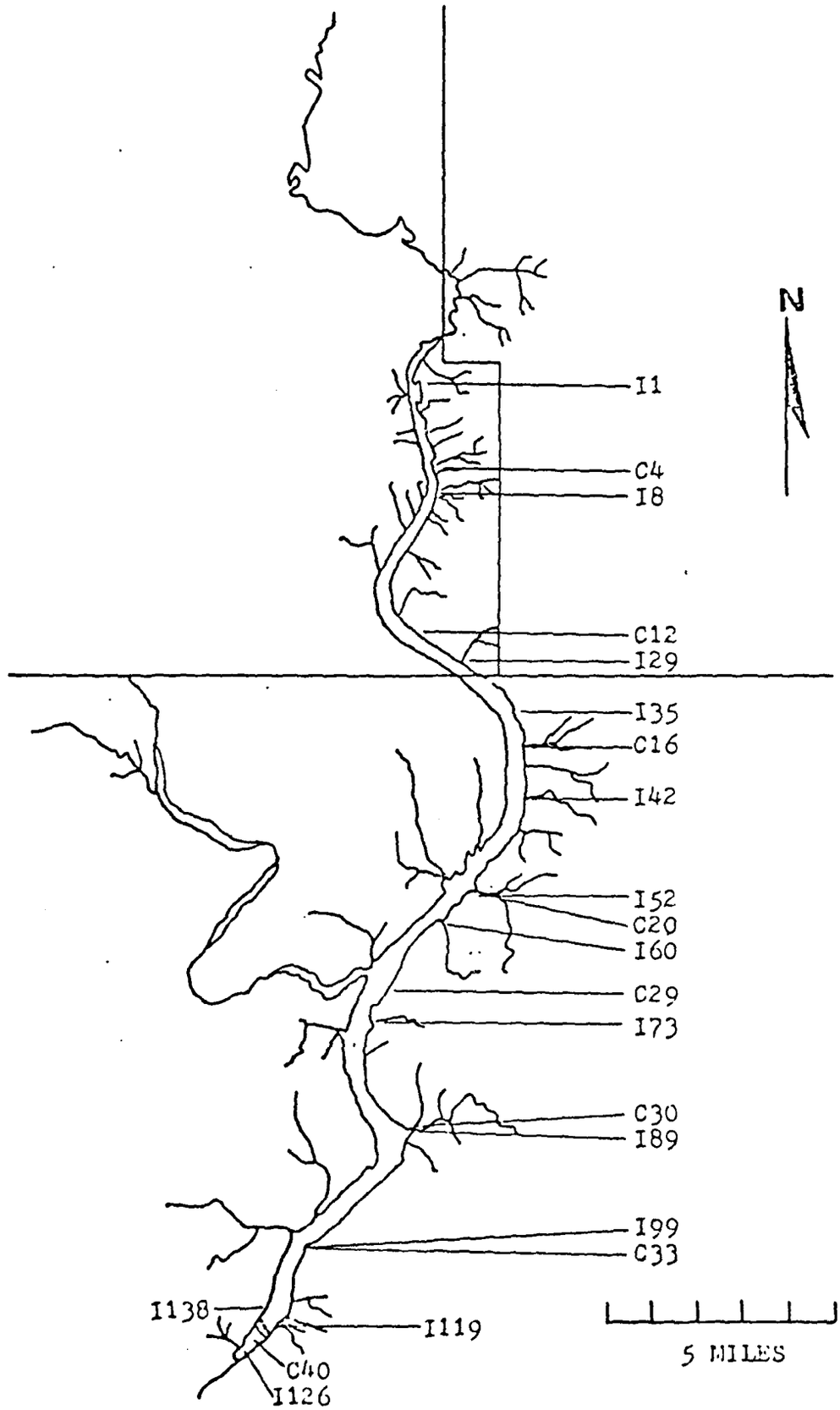


Figure #4 Slide Summary

SLIDE NUMBER	PROBABILITY	COMMENTS
1	L	
2	M	Upper center
3	M	Left
4	M	Center
5	L	
6	L	
7	L	
8	M	Upper right
9	L	
10	M	Extreme left
11	M	Center
12	L	
13	L	Partially wooded
14	L	Partially wooded
15	M	Upper left
16	M	Center
17	M	Upper right corner
18	M	Center
19	M	Upper left, upper center, upper right
20	M	Upper right corner, upper left corner
21	L	
22	L	
23	L	
24	L	
25	L	
26	L	Historic disturbance

SLIDE NUMBER	PROBABILITY	COMMENTS
27	L	Historic disturbance
28	L	Heavy vegetation and historic disturbance surface identification impossible
29	L	Heavy vegetation, surface identification impossible
30	M	Center
31	M	Center
32	M	Top center
33	L	
34	H	32BA7
35	H	32BA7
36	H	32BA7
37	M	Upper right corner
38	L	
39	L	
40	L	
41	L	
42	L	
43	M	Lower right corner
44	L	Historic disturbance and wooded
45	L	Historic disturbance and wooded
46	L	Historic disturbance and wooded
47	L	Historic disturbance and wooded
48	L	Wooded
49	L	
50	L	

SLIDE NUMBER	PROBABILITY	COMMENTS
51	H	Lower center (32BA1)
52	H	Lower center (32BA1)
53	M	Lower center (32BA1)
54	L	
55	L	
56	M	Upper right corner
57	L	
58	L	Extensive historic disturbance
59	L	
60	L	
61	L	
62	L	Historic disturbance and wooded
63	L	Historic disturbance and wooded
64	L	
65	L	
66	L	
67	L	
68	L	Moderately wooded
69	L	
70	L	Low oblique-no data
71	L	
72	L	Low oblique-no data
73	L	
74	L	

SLIDE NUMBER	PROBABILITY	COMMENTS
75	M	Upper center
76	L	
77	L	
78	L	
79	L	
80	M	Center
81	L	
82	L	
83	L	
84	L	
85	L	
86	L	
87	L	Extensive historic disturbance
88	L	Extensive historic disturbance
89	L	Wind rowed field
90	L	Extensive historic disturbance and wooded
91	L	Extensive historic disturbance and wooded
92	L	Extensive historic disturbance
93	L	Historic disturbance
94	L	Historic disturbance
95	L	Wooded-surface identification impossible
96	L	Wooded-surface identification impossible
97	L	Extensive historic disturbance
98	L	
99	L	

SLIDE NUMBER	PROBABILITY	COMMENTS
100	L	
101	L	
102	M	Upper right hand corner
103	L	
104	L	
105	L	
106	L	Historic disturbance
107	L	Wooded, surface identification impossible
108	L	Extensive historic disturbance
109	L	
110	L	
111	L	
112	M	Center
113	L	
114	M	
115	L	
116	L	
117	L	
118	H	East side of fence. Note concentric clust of infrared discoloration
119	L	Extensive historic disturbance
120	L	Extensive historic disturbance
121	L	
122	L	
123	M	Wind rowed field, high reflection
124	L	

SLIDE NUMBER	PROBABILITY	COMMENTS
125	L	Sun glare caused over exposure
126	H	Cultural habitation in upper center
127	H	Cultural habitation in upper center
128	H	Three areas of high probability in upper right hand corner. Note crescent-shaped pattern of circular or semi-circular distribution most of which are 20' to 40' accross in center of infrared concentration
129	H	Same area shot at different angle
130	L	Medium oblique
131	L	Medium oblique
132	L	General farming area around dam
133	L	Historic disturbance-dam construction
134	M	Disc-shaped discoloration in upper right hand corner. Ridge overlooking run-off channel into lake
135	M	Different angle of shot
136	M	Different angle of shot
137	L	
138	L	

along the lake which were defined here as having low probability also be investigated. We would like to believe that all of the areas of high probability and a reasonable proportion of the moderate probability areas will contain evidence of significant prehistoric cultural activity. While on the other hand, few of the areas of low probability will yield such evidence.

The gulf between hope and reality is sometimes as wide as Lake Ashtabula. It is our belief, however, that a significant difference in our defined categories can be demonstrated. Probabilistically speaking, this will certainly be less than 1.0. But if the methodology can identify some of the cultural resources and, as we suggest, aid in the evaluation of others, then it will prove to be beneficial in terms of both time and money.

We would suggest that future projects of this nature make the following changes. First, the comparitive true color transperancies should be shot vertically to allow for greater comparability. Second, a larger format camera should be used if possible to increase the resolution and sharpness. Third, field checking should be a part of the project from the onset to avoid breaking up a project that should be an integrated whole.

Further uses of this methodology must be accompanied by and be a part of archaeological field investigation. It should be possible, with a thorough set of aerial transperancies, to minimize various aspects of the field process and allow for focus of subsurface activities in areas of highest significance.

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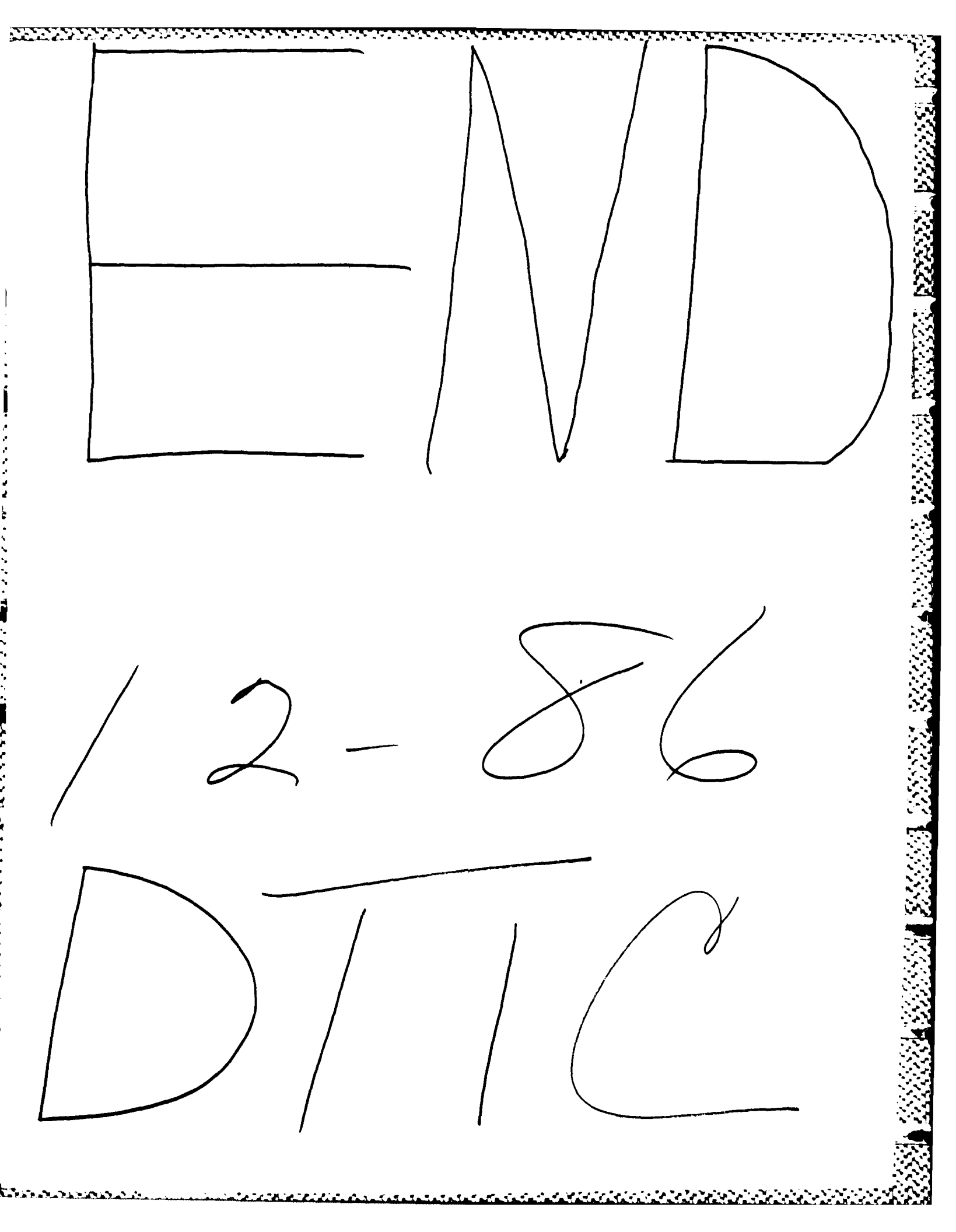
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